REMARKS

The application has been amended to make editorial changes, correct spelling errors, resolve issues raised by the Examiner, and further improve the clarity of the claims.

With respect to claim 1 in particular, Applicants have amended the concentration of iridium complex compound from "0.5 wt% to 8 wt%" to "0.5 wt% to 6 wt%". The invention claimed in the amended claim 1 is characterized by such concentration of iridium complex compound in the light emitting layer made of a carbazole compound. The Example beginning at line 22 on page 24 in the present application, the table on page 26, and Fig. 6 and particularly Fig. 7 show a specific dependency of luminance half-life period of the organic EL element on the concentration of $Ir(ppy)_3$ contained in the light emitting layer. The inventors have discovered such a nature of an organic EL element having a light emitting layer of carbazole compound including the iridium complex compound. Namely, too high or too low of a concentration of $Ir(ppy)_3$ in the light emitting layer is not suitable for increasing the luminance half-life period of the EL element. Thus, the inventors have found a pertinent concentration for $Ir(ppy)_3$ ranging from 0.5 wt% to 6 wt% in the light emitting layer of the EL element.

In addition, the recitation of a light emitting layer including an iridium complex compound at a concentration of 0.8 wt% to 4 wt% in new claim 9 is supported by the disclosure at page 27, line 27 through page 28, line 3 in the specification.

Entry of the above amendments is respectfully requested.

Preliminary Matter

On the Office Action Summary, the Examiner indicates that the certified copy of the priority document has not been received.

On review, Applicants note that the certified copy of the priority document was filed on August 29, 2001 (together with the 5 sheets of formal drawings acknowledged by the Examiner in paragraph 1 on page 2 of the Office Action), as can be seen from the attached Submission of Priority Document and filing receipt date-stamped by the PTO on August 29, 2001. Accordingly, Applicants respectfully request that the Examiner indicate in the next communication from the PTO that the certified copy of the priority document has been received.

Objection to the Disclosure

On page 2 of the Office Action, in paragraph 2, the Examiner has objected to the disclosure because of various informalities.

In response, Applicants have amended the disclosure to resolve the issues raised by the Examiner. Accordingly, withdrawal of this objection is respectfully requested.

Rejection under 35 U.S.C. §112, Second Paragraph

On page 2 of the Office Action, in paragraph 3, claims 1-8 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

The Examiner's Position

The Examiner raises the following issues with respect to the claims in the present application:

(1) Based on the formulae in the specification, the terms "carbasol", "dicarbasol" and carbasolyl" as recited in one or more of claims 1, 3 and 4 should apparently be --carbazole--, --dicarbazole-- and --carbazolyl--, respectively.

(2) The limitations imposed by the term "main" in the phrase "a main component" as recited in claim 1 are not clear. It is not clear if this language places a specific limitation on the minimum amount of carbazole compound that must be present in the light emitting layer and, if so, if the minimum amount is determined by weight, volume or moles.

(3) Claim 2 recites "said iridium complex compound is tris(2-phenylpyridine)" but tris(2-phenylpyridine) *per se* is not an iridium complex compound. The Examiner suggests inserting --iridium-- after the closing parenthesis.

(4) It is not clear if the layer having a hole transport capability that must be disposed between the anode and the light emitting layer according to claim 5 can be the same layer as the hole injecting layer that is laminated in contact with the anode according to claim 1. If not, clarification is requested as to whether claim l's recitation that the hole injecting layer is "laminated in contact with said anode" requires that the hole injecting layer be in physical contact with the anode. Claim 5 does not limit the spatial relationship between the hole injecting layer and the layer having hole transport capability.

Applicants' Response

In response to the issues raised by the Examiner, Applicants have the following comments:

(1) With respect to the first issue raised by the Examiner, Applicants have amended the terms "carbasol", "dicarbasol" and carbasolyl" as recited in one or more of claims 1, 3 and 4 to --carbazole--, --dicarbazole-- and --carbazolyl--, respectively.

(2) Regarding the second issue raised by the Examiner, Applicants have deleted the "main component" recitation to obviate this issue.

(3) As to the third issue raised by the Examiner, Applicants have adopted the Examiner's suggestion of inserting --iridium-- after the closing parenthesis in claim 2.

(4) In regard to the fourth issue raised by the Examiner, it is clear that the one or more layers having a hole transport capability that must be disposed between the anode and the light emitting layer according to claim 5 are in addition to the hole injecting layer that is laminated in contact with the anode according to claim 1, since claim 5 recites "further" comprising the one or more layers. The recitation in claim 1 that the hole injecting layer is "laminated in contact with said anode" requires that the hole injecting layer be in physical contact with the anode, since it recites "in contact".

In view of the above, Applicants submit that the present claims satisfy the requirements of 35 U.S.C. §112, second paragraph. Accordingly, withdrawal of this rejection is respectfully requested.

Anticipation Rejection over Baldo et al

On page 4 of the Office Action, in paragraph 5, claims 1-3, 5, 7 and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Baldo et al in *Appl. Phys. Lett.* 75(1), pp. 4-6 (July 5, 1999).

The Examiner's position is set forth in detail in the Office Action and will not be repeated here for purposes of brevity.

Applicants respectfully submit that the present invention is not anticipated by (or obvious over) Baldo et al, and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

Initially, Applicants submit that Baldo et al discloses conventional organic light-emitting devices based on electrophosphorescence employing the $Ir(ppy)_3$ doped into 4,4'-N,N'-dicarbazole-biphenyl host. It discloses a hole transporting layer of α-NPD or 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl, a light emitting layer of CBP or 4,4'-N,N'-dicarbazole-biphenyl doped with $Ir(ppy)_3$ or tris(2-phenylpyridine) iridium doped, a hole blocking layer of BCP or 2,9-dimethyl-4,7-diphenyl-1, 10-phenanthroline, and an electron transporting layer of Alq3 or tris(8-hydroxyquinoline) aluminum.

Further, Applicants note that Fig. 2 of Baldo et al shows the changes of quantum efficiency of six examples of devices which contain $Ir(ppy)_3$ at concentrations of 1%, 6%, 12%, and 100% in the light emitting layer with respect to current density applied thereto.

However, Applicants submit that Baldo et al fails to disclose that the luminance half-life period of the organic EL element depends on the concentration of $Ir(ppy)_3$ contained in the light

emitting layer, although it taught the maximum quantum efficiency achieved for the $Ir(ppy)_3$:CBP devices at an $Ir(ppy)_3$ concentration of 6-8%. In general, Fig. 2 of Baldo et al merely implies that the luminance half-life period and the driving current value are in substantially inverse proportion to each other. Therefore Baldo et al does not teach or suggest any organic EL device having an improved luminance half-life period caused by the specific iridium complex compound concentration of 0.5 wt% to 6 wt%, as stated in the amended claim 1.

In view of the above, Applicants submit that the present invention is not anticipated by (or obvious over) Baldo et al. Accordingly, withdrawal of this rejection is respectfully requested.

Anticipation Rejection over Tsutsui et al

On page 5 of the Office Action, in paragraph 6, claims 1-3 and 5-8 are rejected under 35 U.S.C. 102(b) as being anticipated by Tsutsui et al in *Jpn. J. Appl. Phys.* 38, pp. L1502-L1504 (December 15, 1999).

The Examiner's position is set forth in detail in the Office Action and will not be repeated here for purposes of brevity.

Applicants respectfully submit that the present invention is not anticipated by (or obvious over) Tsutsui et al, and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

Initially, Applicants submit that Tsutsui et al discloses conventional organic light-emitting devices with iridium complexes. It discloses an α-NPD hole transporting layer, an $Ir(ppy)_3$ doped CBP emitting layer, a BCP hole blocking layer, and an Alq_3 electron transporting layer. Fig. 1 of Tsutsui et al shows the changes of quantum efficiency of three examples of devices which contain $Ir(ppy)_3$ at concentrations of 2.3%, 6.5%, and 9.8% in the light emitting layer with respect to current density applied thereto. Tsutsui et al also teaches the highest quantum efficiency achieved for the $Ir(ppy)_3$:CBP device at an $Ir(ppy)_3$ concentration of 6.5 wt%. Fig. 3 of Tsutsui et al shows that the decay of luminance for three organic EL elements with the 6.5 wt% $Ir(ppy)_3$ concentration CBP emitting layer.

However, Fig. 2 of Tsutsui et al merely implies that the decay of luminance and initial luminance (i.e., driving current value) are in substantially inverse proportion to each other. Tsutsui et al does not show any specific dependency of decay of luminance in the organic EL element as shown in Fig. 7 of the present application.

Thus, Applicants submit that the present invention is not anticipated by (or obvious over) Tsutsui et al. Accordingly, withdrawal of this rejection is respectfully requested.

Anticipation Rejection over Hosokawa

On page 6 of the Office Action, in paragraph 7, claims 1-8 are rejected under 35 U.S.C. 102(e) as being anticipated by Hosokawa (US 2002/0045061 Al).

The Examiner's position is set forth in detail in the Office Action and will not be repeated here for purposes of brevity.

Applicants respectfully submit that the present invention is not anticipated by (or obvious over) Hosokawa, and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

Basically, Applicants submit that although Hosokawa shows carbazole compounds for the light emitting layer of an organic EL element, Hosokawa fails to disclose the luminance half-life period of the organic EL element which depends on the concentration of $Ir(ppy)_3$ contained in the light emitting layer of the organic EL element, as show in Fig. 7 of the present application.

Thus, Applicants submit that the present invention is not anticipated by (or obvious over) Hosokawa. Accordingly, withdrawal of this rejection is respectfully requested.

First Obviousness Rejection

On page 7 of the Office Action, in paragraph 9, claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Baldo et al. as applied under 35 U.S.C. 102(b) above or over Tsutsui et al. as applied under 35 U.S.C. 102(b) above, either reference further in view of JP 2000-21572.

The Examiner's position is set forth in detail in the Office Action and will not be repeated here for purposes of brevity.

Applicants respectfully submit that the present invention is not obvious over Baldo et al. or Tsutsui et al., either reference further in view of JP 2000-21572, and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

Initially, Applicants submit that amended claim 4 defines a combination of the features that the carbazole compound is 4,4',4"-tris(N-carbazolyl) triphenylamine in the light emitting layer and that the iridium complex compound concentration is 0.5 wt% to 6 wt% therein.

As discussed above, both Baldo et al and Tsutsui et al do not show any dependency of luminance half-life period of the organic EL element on the concentration of $Ir(ppy)_3$ contained in the light emitting layer thereof, as show in Fig. 7 of the present application.

JP 2000-21572 discloses the carbazole compound required by claim 4 and the carbazole compound required by claim 3, and teaches that these compounds can be used in a light emitting layer of an electroluminescent device.

However, JP 2000-21572 does not show any specific dependency of luminance decay in the organic EL element as show in Fig. 7 of the present application. Moreover, there is no disclosure in JP 2000-21572 which would motivate one to combine the conventional multiple layered structure with such a specific concentration limitation of $Ir(ppy)_3$ in the light emitting layer.

Thus, Applicants submit that the present invention is not obvious over Baldo et al. or Tsutsui et al., either reference further in view of JP 2000-21572. Accordingly, withdrawal of this rejection is respectfully requested.

Second Obviousness Rejection

On page 8 of the Office Action, in paragraph 10, claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baldo et al as applied under 35 U.S.C. 102(b) above or

over Tsutsui et al as applied under 35 U.S.C. 102(b) above, either reference further in view of Mori et al. (US 5,281,489) or Applicants' allegedly admitted prior art.

The Examiner's position is set forth in detail in the Office Action and will not be repeated here for purposes of brevity.

Applicants respectfully submit that the present invention is not obvious over Baldo et al. or Tsutsui et al., either reference further in view of Mori et al or Applicants' allegedly admitted prior art, and request that the Examiner reconsider and withdraw this rejection in view of the following remarks.

Initially, Applicants submit that claims 5 and 6 define combinations of a multilayer structure and the feature of a concentration of 0.5 wt% to 6 wt%.

As discussed above, both Baldo et al and Tsutsui et al do not show any dependency of luminance half-life period of the organic EL element on the concentration of $Ir(ppy)_3$ contained in the light emitting layer thereof, as show in Fig. 7 of the present application.

Mori et al teaches the use of multiple layers having the functions of hole injecting and/or transporting, and the use of multiple layers having the functions of electron injecting and/or transporting.

However, Mori et al do not show any specific dependency of luminance decay in the organic EL element as shown in Fig. 7 of the present application. Moreover, there is no disclosure in Mori et al to motivate one to combine the conventional multiple layered structure with such a specific concentration limitation of $Ir(ppy)_3$ in the light emitting layer.

Further, it is submitted that the use of multiple layers having the functions of hole injecting and/or transporting, and the use of multiple layers having the functions of electron injecting and/or transporting in the art is not necessarily admitted in the first paragraph in the description of the related art on page 1 of the present specification. However, even if it were admitted, the Examiner's combination including such an admission would not render the present invention obvious, based on the same reasoning as that set forth above with respect to the Examiner's combination including Mori.

Thus, Applicants submit that the present invention is not obvious over Baldo et al. or Tsutsui et al., either reference further in view of Mori et al or Applicants' allegedly admitted prior art. Accordingly, withdrawal of this rejection is respectfully requested.

Miscellaneous Matter

On page 9 of the Office Action, in paragraph 11, the Examiner indicates that the phrase "layer comprises of a carbasol compound" is grammatically incorrect (claim 1, line 6).

Applicants thank the Examiner for identifying this grammatical error. In response, Applicants have amended claim 1 to resolve this issue.

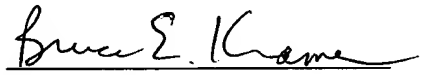
Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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Date: March 17, 2003

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 2, paragraph bridging pages 2 and 3:

In recent years, utilization of a phosphorescent material in the light emitting layer of the organic EL element has been proposed in addition to the fluorescent material (D. F. O' Brien and M. A. Baldo et al "Improved energy transfer in electrophosphorescent devices" Applied Physics letters Vol. 74 No. 3, pp 442-444, January 18, 1999; M. A. Baldo et al "Very high-efficiency green organic light-emitting devices based on electrophosphorescence" Applied Physics letters Vol. 75 No. 1, pp 4-6, July 5, 1999; Tetsuo Tsutsui et al "High quantum efficiency in organic light-emitting devices with Iridium-complex as a triplet emissive center" JJAP Vol. 38(1999) No. 12B in press, pp [?-?] L1502-L1504). Organic materials are excited when carrier electrons or holes injected by an electric field are recombined, and emit light when they fall down to a ground state. In this event, excited organic molecules take a single excited state of high energy (electrons exhibit reverse spin) and a triplet excited state of low energy (electrons exhibit normal spin). The luminescence is classified according to the duration of afterglow after the supply of excitation energy is stopped, and generally classified into fluorescence when the afterglow lasts for several nano seconds and phosphorescence when the afterglow lasts for several micro seconds. But this classification is not exact strictly. In the phosphorescence, light emission duration decreases in proportion to the elevation in ambient temperature. On the other hand, in

the fluorescence, the duration of afterglow does not depend on the temperature and the afterglow process is extremely rapid.

Page 4, paragraph bridging pages 4 and 5:

An organic EL element according to the present invention has a laminate of an anode, a hole injecting layer made of an organic compound and laminated in contact with the anode, a light emitting layer made of an organic compound, an electron transport layer made of an organic compound and a cathode, wherein said light emitting layer comprises of a [carbasol] carbazole compound as a main component and includes [a] an iridium complex compound at a concentration of 0.5 wt% to 8 wt%.

Page 5, first full paragraph:

In one aspect of the organic EL element according to the invention, said iridium complex compound is tris(2-phenylpyridine) iridium.

Page 5, second full paragraph:

In another aspect of the organic EL element according to the invention, said [carbasol] carbazole compound is 4,4'-N,N'-[dicarbasol] dicarbazole-biphenyl.

Page 5, third full paragraph:

In a further aspect of the organic EL element according to the invention, said [carbasol] carbazole compound is 4,4',4"-tris(N-[carbasolyl] carbazolyl)triphenylamine.

Page 8, second full paragraph:

In the embodiments, a [carbasol] carbazole compound material, which is a host material as a major component included in the light emitting layer 4 is, for example, 4,4'-N,N'-[dicarbasol] dicarbazole-biphenyl (which is abbreviated as "CBP" in this paper), represented by the following chemical formula (2). Also, 4,4'4,''-tris-(N-[carbasolyl] carbazolyl)triphenylamine, represented by the following chemical formula (3) may be used for the host material in the light emitting layer 4 of the organic EL element.

Page 28, first full paragraph:

Furthermore, instead of CBP, 4,4',4''-tris(N-[carbasolyl] carbazolyl)triphenylamine was used for the host material in the light emitting layer of the organic EL element and [resulting] resulted in the similar effect to the above embodiment. It was therefore confirmed that the concentration of iridium complex compound in the light emitting layer of the [carbasol] carbazole compound ranging from 0.5 wt% to 8 wt% provides the effectiveness in prolonging lifetime of the organic EL element.

Page 28, second full paragraph:

As described above, according to the present invention, the light emitting layer comprises [of] a [carbasol] carbazole compound as a main component and includes [a] an iridium complex compound at a concentration of 0.5 wt% to 8 wt%, thereby providing an organic EL element which can emit light for a long time period.

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) An organic electroluminescence element having a laminate of an anode, a hole injecting layer made of an organic compound and laminated in contact with said anode, a light emitting layer made of an organic compound, an electron transport layer made of an organic compound, and a cathode, wherein said light emitting layer [comprises] is made of a [carbasol] carbazole compound [as a main component] and includes [a] an iridium complex compound at a concentration of 0.5 wt% to [8] 6 wt%.

2. (Amended) An organic electroluminescence element according to claim 1, wherein said iridium complex compound is tris(2-phenylpyridine) iridium.

3. (Amended) An organic electroluminescence element according to claim 2, wherein said [carbasol] carbazole compound is 4,4'-N,N'-[dicarbasol] dicarbazole-biphenyl.

4. (Amended) An organic electroluminescence element according to claim 2, wherein said [carbasol] carbasole compound is 4,4',4''-tris(N-[carbasolyl] carbazolyl) triphenylamine.

Claim 9 is added as new a claim.

IN THE ABSTRACT OF DISCLOSURE:

The abstract is changed as follows:

An organic electroluminescence element has a laminate of an anode, a hole injecting layer made of an organic compound and laminated in contact with [said] the anode, a light

emitting layer made of an organic compound, an electron transport layer made of an organic compound, and a cathode. The light emitting layer [comprises of] includes a [carbasol] carbazole compound as a main component and includes [a] an iridium complex compound at a concentration of 0.5 wt% to 8 wt%.